Spatial autocorrelation in abundance models accounting for imperfect detection

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Abstract: Reliable maps of abundance are fundamental tools in ecology and applied fields such as biodiversity monitoring and conservation. However, two common problems are (i) interpretational challenges due to the complex observation process (e.g. imperfect detection) underlying most ecological field data and (ii) residual spatial autocorrelation. These may jeopardise our ability to draw inferences about abundance and produce underestimates of uncertainty. To investigate the consequences of these problems we fit four different models on simulated datasets using a bayesian framework: a standard generalized linear model, an N-mixture model (Royle 2004), an N-mixture model accounting for spatial autocorrelation using an intrinsic conditional autoregressive (ICAR) prior and another N-mixture model also accounting for spatial autocorrelation using two-dimensional penalized splines of the geographic coordinates. Knowing the true abundance distributions we can compare the predictive abilities of the models using different statistical measures. We also investigate the coverage rates of the credible intervals of the coefficients. We then apply the same models to several species using replicated count data coming from a Swiss breeding bird dataset and make predictions for the whole of Switzerland. The models are compared and validated using an independent dataset, and uncertainty maps are also computed.

References:

Royle, J. A. (2004). N-mixture models for estimating population size from spatially replicated counts. *Biometrics*, 60:108–115.